APPARATUS INCLUDING A SUCKER WITH AUTOSELECTION FUNCTION FOR HANDLING MATERIAL

RELATED U.S. APPLICATIONS

Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

REFERENCE TO MICROFICHE APPENDIX

Not applicable.

FIELD OF THE INVENTION

[0001] This invention refers to an apparatus including at least one sucker, with a vacuum obtained by means of the Venturi effect or by means of a vacuum pump, with an auto-selection function for handling material of the type in sheets or objects that lend themselves to being handled with this system.

[0002] The invention finds particular application where the vacuum is used non-exclusively in the metal plate moving sectors.

BACKGROUND OF THE INVENTION

[0003] In the field of industrial automations, for example, installations working <<unmanned>> or "lights off", namely without human presence, the invention assumes particular interest.

[0004] One of the characteristics that distinguishes said installations, is the fact that each installation

is prepared during day hours for functioning without human presence during nocturnal hours.

[0005] A typical case is illustrated by the installations in which automatic systems are provided for loading, on the construction line, and unloading of materials to be submitted to processing, such as metal sheets, plastic material plates, ceramic and glass, with the aim of allowing processing to be carried out continuously without the need to intervene at the end of every operative cycle. Said systems, for example, are required in sheet cutting installations, those employing laser or plasma techniques, oxygen cutting, water techniques and also others.

[0006] Generally, therefore, it is possible to consider that this concerns installations subdivided into at least two working areas, respectively an upstream unit, including the group loader-feeder of the material in sheets, an intermediate station, for instance made up of the cutting apparatus, and a possible downstream adjacent unit including a stacker-ejector of the sheet processed in this way.

[0007] With respect to these installations, certain drawbacks have been observed by operators in this sector, above all with reference to the most common grill or bench material loading systems in the intermediate station.

[0008] Among the most well-know systems, proposed for loading and unloading the sheeting, for example using a cutting apparatus grill or a bench for a folding press, it is possible to cite substantially five techniques.

[0009] The first of the four, the primary technique is known for manual removal of pieces cut from a grill or bench with the subsequent loading of the new sheet, by means of an overhead crane, fork truck, purchase block or sucker frame mounted on a fixed oscillating arm.

[0010] A second solution consists in providing two grills or benches, operating on the cutting or processing installation, in such a way as to be operated alternatively on a grill for loading and

unloading, while the other is functioning. A third solution, for sheet cutting installations, is intended to optimize the system which in the previous point provided a carousel with a certain number of grills, collected in a vertical warehouse.

[0011] A fourth solution, suitable for interacting with one of the systems described previously with respect to the unloading of the grill, provides a vertical warehouse upstream of the cutting unit, with more shelves, where the sheets to be processed are pre-arranged, in such a way that, according to the program, an extractor or handler with suckers can pick up and transfer the material on the grill of the intermediate unit so it can be processed.

[0012] PRIOR ART

[0013] Therefore, suckers are known the in the field of assistance for machine tools and in other sectors, which, supported by conventional systems, are made to adhere the peripheral border of the circular flange to the flat surface of the underlying material to be handled. Once placed in contact, a temporary depression is produced, substantially, which causes the material to remain in contact with said suckers. In this way the suckers, raising themselves from the support base of the material, will determine the subsequent transfer of the material to an adjacent station. Once placed in the release position, a device provides the re-balancing of the pressure on the interior of the cups of the suckers, allowing the detachment of the material. It is therefore evident given that said suckers are connected to systems that allow depression generation and re-balancing of the sucker once certain conditions have been reached. More particularly, said devices utilize the Venturi effect or in some cases a common vacuum pump.

[0014] Therefore, for example in US5979889 (Klopfenstein), a practical application of the Venturi effect for generating a depression in the sucker cup is described. In detail, the sucker is mounted with

the tubular connector along a main rod that is channelled to intersect it on the bias. A second connector is coaxial to the main channelled rod and develops until passing beyond the interconnection point with the tubular pin. In this way, by introducing a fluid through the second connector, the air present in the cup in contact with the material is sucked again, so that the sucker remains in very close contact or adhered to the surface of the material to be handled.

[0015] Also US5928537 (Fortune) describes a system that uses the Venturi effect to generate a vacuum on the interior of a sucker. In more detail, a tool for lifting small portions of materials is proposed, which is provided on one side with a sucker and is connected on the other side to a vacuum generator. Said vacuum generator is connected on one side to a first ON/OFF valve that allows the emission of compressed air and on the other side, downstream of the circuit, to a second valve that connects with the exterior. Operating with the first valve in open position, the compressed airflow crosses the vacuum generator that is in contact by means of a connector with the tool provided with a sucker. The compressed airflow finds a vent in a downstream position set apart with respect to the tool's connector and continues through the second valve in open position. In this way, the necessary re-suction is produced along the tool's connector, so that the sucker remains in the position of being adhered to the material. Operating inversely, thus closing the second valve, which is downstream of the circuit, the compressed airflow passes across the tool's connector and therefore re-balances the pressure on the interior of the cup obtaining the detachment of the material.

[0016] STATE OF THE ART MOST SIMILAR TO THE INVENTION

[0017] US4750768 (Kumar), describes an adhering device. This substantially concerns a pneumatic vacuum generator that uses an amp fluid sensor that senses the presence of an object when said object is in contact with the sucker cup. This circumstance activates the main Venturi effect vacuum

generator that provides for forming the vacuum necessary that makes it possible for the object to be lifted. An external release signal determines the arrest of the vacuum to release the object. The energy for the vacuum, in this case, is to be generated only when the object is lifted, in such a way as to suppress energy consumption and noise. Furthermore, it is possible to adjust the level of force necessary for lifting. The fluid logic circuit, automatically blocks the vacuum in the sucker, while the supply to the main Venturi is placed in the OFF position after a pre-established period of time.

[0018] US5795001 (Burke) describes a device for manipulating articles. The small hand contains a sucker that cooperates with a circuit that includes an electric motor coupled to a vacuum pump. An electronic circuit allows the operator to control directly the application of vacuum to the sucker. Furthermore, an electronic circuit detects the prolonged vacuum between the sucker and the object to be handled and if this reaches a predetermined low level, the electronic circuit informs the operator of the condition and automatically re-starts the motor of the vacuum pump until the depression level is re-established. An alternative solution to this invention provides for a Venturi effect vacuum generator that can substitute directly the module that includes the vacuum pump.

[0019] In conclusion it is correct to affirm that at present it is known that for the formation of the vacuum in said suckers, a Venturi for each sucker or a Venturi for several suckers is applied, and if a depression greater than that which can be generated by a Venturi was necessary, it is possible to resort to a vacuum pump that, also in this case, can be applied to one or several suckers.

[0020] DRAWBACKS

[0021] In terms of the systems described with the Venturi effect, these present an economical advantage and are simple to apply. For example, in the case of the use of several suckers and one Venturi for each of these, it is guaranteed that if one or several suckers does not completely adhere

to the object, the depression in the other suckers is maintained, thus ensuring the lifting or transportation of the piece. In this case it is evident that the suckers that are not able to create the vacuum continue to be supplied thus giving rise to the wastage of compressed air. To compensate for the air loss problem, manual taps can be applied that block the Venturi supply of the sucker to be excluded. However, it is evident that this solution appears inconvenient since manual intervention is required. From a practical point of view, this circumstance involves the stoppage of the installation causing increased down times, in one case, it can require processing on flat material pieces that often present different dimensions or are not perfectly aligned and coplanar.

[0022] Others systems, to avoid the air loss problem and to manage the valves manually, provide the application of electro-valves. These systems involve the use of management software, of electric wiring or, in the more economic version, a series of switches. From a practical point of view, the proposal causes considerable complexity in the installations with the relative implementation and maintenance costs. However, to this can be added the fact that the proper positioning of the piece to be lifted is necessary in order to avoid the useless supply to the suckers that are not involved.

[0023] In the case in which, unlike the Venturi system, it is possible to opt for an installation with a vacuum pump, or with a Venturi for the entire installation, it is necessary to define from the start of processing the suckers that activate the adhering function and those that do not. In this hypothesis, in the event that a good adherence is not provided or the sucker detaches, it would cause the depression to decline in the entire installation, thus provoking the detachment of the object from the other suckers (and eventually the stoppage of the installation).

[0024] Other systems, not mentioned previously include a relief valve where given the possible unsuccessful adherence of the object, the aspirated airflow will close the passage thus eliminating

the vacuum supply. It is the opinion of the applicant that this system is not reliable, since it requires an ample aspiration flow in order for the device to in turn be able to stop the it. In a second system a small hole would always remain, through which air from the exterior continues to be sucked, thus it is not airtight.

[0025] Here there is the need for the companies to determine alternative and more effective systems not including those described previously.

[0026] One aim of this invention is also to avoid the above-mentioned drawbacks.

BRIEF SUMMARY OF THE INVENTION

[0027] This and other aims are reached with this invention according to the characteristics as in the included claims, solving the arising problems, by means of an apparatus for handling material of the type in sheets or portions of flat sheets, including at least one device with an autoselection function for the lifting-release of the material, of the type with a vacuum that is obtained between the sucker and the material, by vacuum forming means through the Venturi effect or by means of a vacuum pump; this apparatus is made up of a multi-way pneumatic supply circuit of an auto-selection and auto-relief valve that includes principal pneumatic commutators, said commutators being interconnected to a third commutator that is interposed between the vacuum forming means and the auto-selection valve that supplies the sucker.

[0028] AIMS OF THE INVENTION

[0029] The considerable creative contribution, verified in the proposal now described, constitutes an immediate technical progress in order to obtain different advantages.

[0030] First of all, one aim consists in conferring additional safety to the system described. The

principle is based substantially on the autorelief of the formation of the vacuum created in the sucker, so that in a series of suckers those that are not adhered are excluded automatically. For example, in the event that in an installation a sucker is positioned close to the edge of the piece to be raised (ref. Fig. 13) and thus experiences a small loss of air, causing the detachment of the adherence, the vacuum is aspirated through this sucker and also serves to reduce the depression in the other suckers thus letting the piece fall (if the installation has the Venturi effect or a centralized vacuum pump). With the above-described system this situation would not occur since the sucker in adherence would automatically be excluded without compromising the proper functioning of the others. From a practical point of view, consequently, operator intervention and control as well as the use of complex management software would be avoided, providing the installation with particular inexpensiveness and reliability. Therefore, almost no maintenance with the implied costs is required, relative to the construction and the installations, rather than contents.

[0031] A further aim consists in considering a notable saving of energy, both because the suckers not involved in the lifting exclude themselves automatically as well as because air consumption is suppressed since the supply is not required until the sucker is maintained within the values of the established depression.

[0032] These advantages have the quite relevant value of producing apparatus with a good technological, multi-functional and extremely reliable content, even if submitted to particular working loads.

[0033] Others advantages will appear from the following specific description of some preferred embodiments, with the aid of the enclosed schematic drawings, whose implementation details are not to be considered limitative, but only illustrative.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0034] Figure 1 is a diagram of the apparatus that is the object of this invention in the rest position, which represents a plan of the pneumatic installation for the supply of the autoselection valve and of the sucker connected to it, cooperating with a Venturi effect vacuum generator, as well as the connecting circuit between them.

[0035] Figure 2 is a diagram of the apparatus that is the object of this invention as in Figure 1, in active position.

[0036] Figure 3 is a diagram of the apparatus that is the object of this invention, as in previous Figures in auto-relief position.

[0037] Figure 4 is a diagram of the apparatus that is the object of this invention, as in previous Figures in stand by / economy position.

[0038] Figure 5 is a diagram of the apparatus that is the object of this invention, as in previous Figures in a position of depression loss in the sucker.

[0039] Figure 6 is a diagram of the apparatus that is the object of this invention, as in previous Figures in a depression reactivation position.

[0040] Figure 7 is a diagram of the apparatus that is the object of this invention, as in previous Figures in a position of detachment from the piece.

[0041] Figure 8 is a diagram of the apparatus that is the object of this invention in the rest position, that represents a plan of the pneumatic installation for supplying the autoselection valve and sucker connected to it, cooperating with a vacuum pump, as well as the connecting circuit between the them.

[0042] Figure 9 is a diagram of the apparatus that is the object of this invention in rest position, that represents one variant of the plan of the pneumatic installation for supplying the auto-selection valve and sucker connected to it, cooperating with a Venturi effect vacuum generator, as well as the connecting circuit between them.

[0043] Figure 10 is a diagram of an apparatus with several suckers, supplied by a vacuum pump.

[0044] Figure 11 is a diagram of an apparatus with several suckers, supplied by a single Venturi effect vacuum generator.

[0045] Figure 12 is a diagram of an apparatus with several suckers, supplied by a corresponding number of Venturi effect vacuum generators.

[0046] Figure 13 is an illustrative plan of certain possible sucker working positions.

DETAILED DESCRIPTION OF THE INVENTION

[0047] With reference also to the Figures, it is observed that in an installation for handling/lifting of flat material, for example, in sheets or pieces of sheet M, an apparatus S1, S2 is provided that includes at least one sucker 1 on the interior of which, when adhered in correspondence to the material M, is to form the vacuum.

[0048] More particularly, the apparatus S1, S2 can be divided into three blocks, respectively A, B and B1 to which at least one sucker is connected I. The block A is made up of a pneumatic installation for supplying the blocks B-B1, which are made up respectively of an auto-selector valve that cooperates with means to generate the vacuum Fl, F2. In this case, said means for generating the vacuum can include a solution with Venturi effect F1 or a vacuum pump F2.

[0049] The block A, is essentially made up of:

- A pressure regulator	1.1
- A first rotary converter electro-valve	1
- A pressure regulator	2.1
- A second rotary converter electro-valve	2
- A pressure regulator	3.1
- A third rotary converter electro-valve	3
- An alternative valve	4

[0050] In terms of the second and third block B-B1, that includes the auto-selection valve, it is substantially made up of:

- A first pneumatic commutator	C
- A second pneumatic commutator	D
- A third pneumatic commutator	E
- A relief valve	G
- A vacuum generator	F1, F2
- Portions of the valves groups C, D, E	0,1 high
	0,0 low

[0051] As a rule, while the block A serves to supply one or several suckers 1, the block B-B1 can be applied to every sucker or group of suckers according to the needs of the installation.

[0052] APPARATUS ACTIVATION PHASE

[0053] In Figure 2 the activation of the circuit of the auto-selection valve (V.A.S.) through a compressed air impulse is represented. This impulse occurs through the excitation of valve 1 and 2 of block A. In terms of the impulse of the air conferred from the electro-valve 1 it is observed that,

passing through the pneumatic commutator C, D and E, it is intended to supply the Venturi effect vacuum generator Fl. On the contrary, the airflow, whose concurrence is provided by an impulse from the electro-valve 2, will supply the pneumatic commutator D in such a way as to establish the movement of the piston D1 in the position 0.1. More particularly, the air originating from the electro-valve 2, passing through the alternative valve 4, moves the sphere 4.1 to position (b), allowing the supply of the circuit P1, which on entering block B determines the movement of said piston D1 in position 0.1 for the duration of the pulse.

[0054] In terms of airflow originating from the electro-valve 1 entering into the block B-B1 through the circuit P, it is observed that this will supply the Venturi F1 and open the relief valve G to activate a depression in the circuit L and therefore maintain the piston D1 in auto-relief position (0.1) maintaining this position only if the sucker I is well positioned.

[0055] The block B-B1 forms part of a third pneumatic commutator E that is connected to said circuit P1 and P. In this position said commutator E does not move, as it requires higher pressure since it is provided with a more rigid spring E2.

[0056] Consequently, the airflow introduced by the electro-valve 1, along the circuit P passes first across the pneumatic commutator C and D, then across the commutator E to supply the Venturi effect vacuum generator Fl. The Venturi F1 forms the vacuum that will thus lift the sphere of the relief valve G in this way supplying the circuit L with a depression that will simultaneously supply the sucker I for the movement of the material M and the piloting of the circuit L. The depression of the piloting on circuit L, passing through the perforations D3 of the shaft of the piston D1, forms an eddy in the upper chamber of the commutator D maintaining the piston D1 in position 0.1, forming an auto-relief circuit. The depression created in the circuit L involves one or more suckers I. The

suckers, adhered to the piece to be moved, even in the event of a small intake of air from the exterior, cause a rapid depression increase in the circuit L until tripping the auto-relief phase of the system (piston D1).

[0057] APPARATUS AUTORELIEF PHASE

[0058] (Ref. Figure 3) At the point when the vacuum has reached a sufficient depression value to maintain the piston D1 in position 0.1 the electro-valve 2 of the block A is to be de-excited. To maintain itself in this position a minimum depression is sufficient; this allows the installation to remain primed even if there are tolerable losses on the suckers themselves. The detainment of the piston D1 in position 0.1 takes place through the depression of the circuit L transmitted across the perforation D3 in the shaft of the piston D1, (that is normally found in position 0.0 pushed by the spring D2) which is held in position 0.1 until the sucker(s) I maintains a tolerable depression hold on the material M. If the sucker I should suffer a heavy loss due to perforations and positioning close to the edge of the material M or completely outside of the latter, by automatically de-exciting the electro-valve 2 of block A, the supply of the Venturi F1 is interrupted. The interruption of the supply of the Venturi F1 can also take place if the sucker I separates from the material M, thus interrupting the auto-relief of piston D1 by blocking the flow and eliminating useless air consumption.

[0059] APPARATUS STAND-BY ECONOMY PHASE

[0060] (Ref. Fig. 4) The depression to be created will continue to increase until reaching the maximum allowed or pre-established. At this point, the piston C1 equipped with a spring C2 (adjustable) sturdier than the spring D2 of the commutator D will be placed in position 0.1 subsequently (reaching the maximum or established depression allowed) with respect to the commutator D. The movement of the piston C1 of the commutator C in position 0.1 will interrupt

the airflow originating from the electro-valve 1 of the block A, destined to supply the Venturi Fl. In this way, useless air consumption is avoided, while the circuit L in maximum depression, will maintain the sucker I in adherence on the material M and this thanks to the tightness of the relief valve G.

[0061] INTERVENTION PHASE IN CASE OF DEPRESSION LOSS

[0062] (Ref. Fig. 5) If the depression of the circuit L, due to small losses, should fall below the maintenance value in position 0.1 of the piston C1 of the commutator C, placing itself in position 0.0, the airflow originating from the electro-valve 1 of the block A will supply the commutator D in position 0.1 which in turn, through the commutator E, will supply the Venturi effect vacuum generator Fl. The latter, creating the depression flow again, re-opens the relief valve G.

[0063] REACTIVATED DEPRESSION PHASE

[0064] (Ref. Fig. 6) On re-opening the relief valve G the depression value of the circuit L returns to the maximum, thus re-positioning the piston C1 of the commutator C to auto-relief in position 0.1 and in this way re-closing the compressed airflow originating from the electro-valve 1 of the block A with the similar closure of the relief valve G.

[0065] DETACHMENT PHASE OF SUCKER I FROM MATERIAL M

[0066] (Ref. Fig. 7) The detachment of the sucker I from the material M takes place while continuing to keep electro-valve 1 of the block A excited and exciting the electro-valve 3 which causes a higher air pressure to flow through circuit P1 than that which flows through the electro-valve 2, in this way moving the sphere 4.1 of the alternative valve 4 into position (a). The air with a higher pressure than that exerted for the activation of the system for the adherence of the sheet will maintain the piston D1 of the commutator D in position 0.1, moreover it will move the cursor El of the commutator E

into position 0.0, thus blocking the supply of the Venturi effect vacuum generator F1 means, bypassing the airflow directly to the circuit L to the sucker I. The latter, on receiving the blast of compressed air, rather than a depression, will detach from the material M rapidly, subsequently the entire system will remain in an apparatus rest position (ref. Fig. 1) to be ready for another cycle.

[0067] The apparatus described above can be utilized even without vacuum generator means of the type with Venturi effect Fl. In this case, instead of supplying the apparatus through the line P with air pressure, it can be supplied directly by a vacuum pump (ref. Fig. 8), or from a single vacuum generator of the type with Venturi effect (Fig. 9), both with dimensions for consumption proportional to the number of suckers employed. The difference with respect to the description of previous functioning (a vacuum generator of the type with Venturi effect for each auto-selection valve) consists in supplying the line P for the sucker detachment phase with a pressurized airflow, exciting the electro-valve 1 and de-exciting the electro-valve 5, when for all the other previous phases it is supplied by a line in depression rather under pressure.